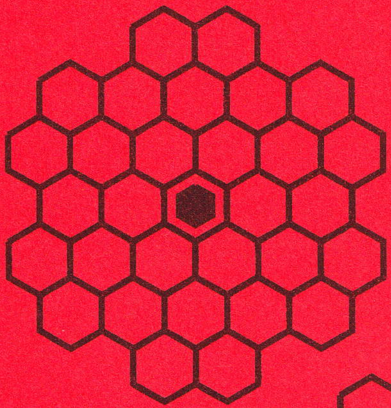
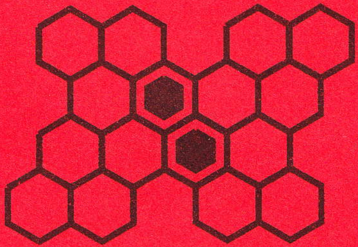
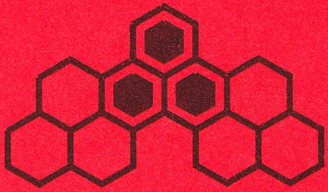
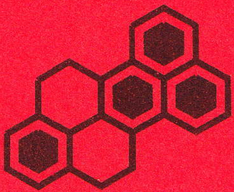
KOLLOQUIUM ÜBER KOMBINATORIK

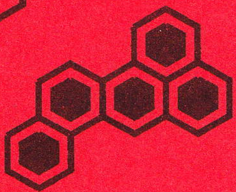
14. und 15.
November
1997











Diskrete
Mathematik

TECHNISCHE UNIVERSITÄT
BRAUNSCHWEIG

Liebe Teilnehmerinnen und Teilnehmer:

Willkommen zum 17. "Kolloquium über Kombinatorik", das zum sechsten Mal hier in der Technischen Universität Carolo-Wilhelmina in Braunschweig stattfinden kann. Neben allen erfahrenen Tagungsbesuchern begrüßen wir besonders diejenigen Teilnehmer, die einen ihrer ersten Konferenzvorträge halten werden, und wir wüschen Ihnen guten Erfolg.

Bei den vielen Freiwilligen, besonders aus unserer Studentenschaft, möchten wir uns an dieser Stelle sehr herzlich für ihre organisatorische Hilfe bedanken.

Dem Präsidenten unserer Technischen Universität, Herrn Professor Dr. Bernd Rebe, danken wir vielmals für seine finanzielle Unterstützung.

Allen Teilnehmern wünschen wir schöne Anregungen aus den Vorträgen und bei den Gesprächen in den Pausen, sowie auch sonst angenehme Stunden in der Stadt Braunschweig, in der sowohl Gauß als auch Dedekind geboren sind.

Heiko Harborth
Arnfried Kemnitz
Christian Thürmann
Hartmut Weiß

Diskrete Mathematik
Technische Universität Braunschweig

Freitag, 14. 11. 1997

9:30 **Eröffnung** (Hörsaal: PK 4.3)

9:45 **G. Sabidussi (Montréal, Kanada)** (Hörsaal: PK 4.3)
"Colouring problems for 4-regular Hamiltonian graphs"

10:40 **Kaffeepause**

10:55 **W.T. Trotter (Tempe, AZ, USA)** (Hörsaal: PK 4.3)
"Open problems in dimension theory for partially ordered sets"

11:50–13:30 **Mittagspause**

Zeit	Sektion I Raum PK 14.3	Sektion II Raum PK 14.4	Sektion III Raum PK 14.6	Sektion IV Raum PK 14.7	Sektion V Raum PK 14.8
13.30	S. Felsner Triangles in Euclidean arrangements	M. Grüttmüller Construction of pairwise balanced designs	P. Johann A grouptesting problem for graphs with several defective edges	T. Böhme On a modification of Hall's Theorem	D. Rautenbach On the differences between the upper irredundance, upper domination and independence numbers of a graph
14.00	J.-P. Allouche Lexicographically extremal overlap-free binary sequences	E.N. Müller Kreuzkorrelation linearer Schieberegisterfolgen	V.B. Le Recognizing perfect 2-split graphs	M. Kriesell Contractible subgraphs in 3-connected graphs	J. Harant On dominating sets and independent sets of graphs
14.30	C. Gröpl Size and structure of ordered binary decision diagrams for random boolean functions	R.-H. Schulz On check digit systems with error correction	S. Urbański Vertex-Folkman numbers	Z. Ryjacek Closure and stable properties in claw-free graphs	H.-M. Teichert Zur Summenzahl von Hypergraphen
15.00	F. von Haeseler A method to identify ultimately periodic p-automatic sequences	H. Hassenpflug Multivariate sequences generated by finite data	S.P. Radziszowski Computation of the Folkman Number $F(3,3;5)$	S. Brandt 9-connected claw-free graphs are Hamilton-connected	E. Triesch The subgraph degree polytope
15.30	W. Hochstättler Large circuits in binary matroids of large cogirth	U. Leck On subword orders	M. Hoeth Ramsey numbers for graphs of order four versus connected graphs of order six	E. Köhler On the recognition of asteroidal triple-free graphs	H. Sachs On a strange observation in the theory of the dimer problem
16.00	**Kaffeepause**				
16.30	R. u. G. Blind Schälungen und das Lower Bound Theorem	Y. Guo A new sufficient condition for a digraph to be Hamiltonian	M. Sonntag Zu Maximalstromalgorithmen in geschichteten Transportnetzen	T. Niessen Polyhedral description of multicolorings	T. Pisanski Haar graphs
17.00	H. Mielke The Penrose polynomial	S. Thomasse Paths in tournaments, a proof of Rosenfeld's conjecture	B. Weißbach Ein weiteres Gegenbeispiel zur Borsukschen Vermutung	B. Randerath A Vizing-type bound for the chromatic number	G. Brinkmann Small critical graphs
17.30	V. Nalivaiko The constructive facet-generating methods for the linear ordering polytope	F. Havet Trees in tournaments	E. Sparla On upper bound conjectures for combinational pseudo-k-manifolds	I. Schiermeyer On extremal problems concerning weights of edges of graphs	S. Hartmann Blowing up graphs
18.00	N. Kuzjurin Almost optimal explicit constructions of asymptotically good packings	M. Tewes Vertex pancyclic digraphs		V. Leck Nonisomorphic drawings of graphs	W. Lang Counting walks on Jacobi-graphs: an application of orthogonal polynomials

19.30 **Gemeinsames Abendessen**
im Restaurant „Zum Burglöwen“, Hotel Deutsches Haus

Sonnabend, 15. 11. 1997

9:45 **W. Mader (Hannover, Deutschland)** (Hörsaal: PK 4.3)
"Topological subgraphs in graphs of given average degree"

10:40 **Kaffeepause**

10:55 **O. Favaron (Paris, Frankreich)** (Hörsaal: PK 4.3)
"Various concepts in domination theory"

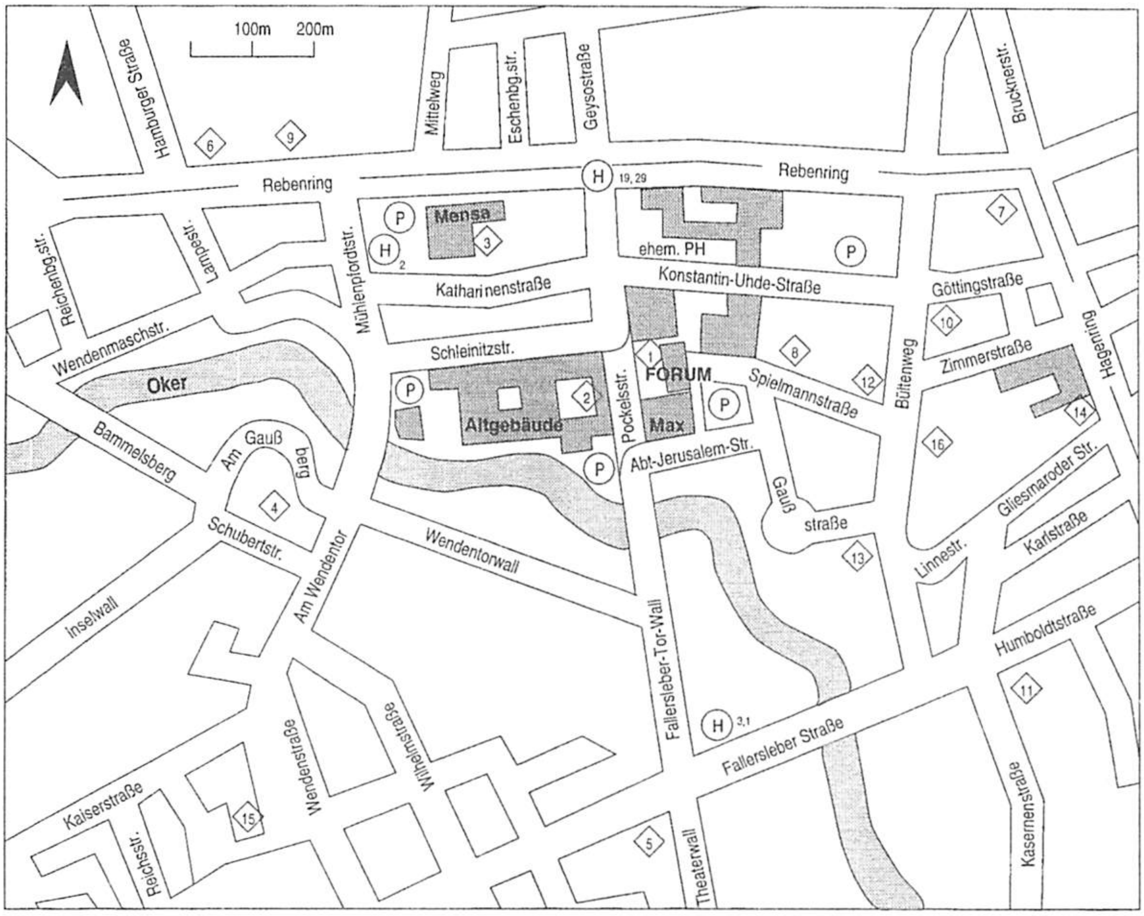
11:50–13:30 **Mittagspause**

Zeit	Sektion I Raum PK 14.3	Sektion II Raum PK 14.4	Sektion III Raum PK 14.6	Sektion IV Raum PK 14.7	Sektion V Raum PK 14.8
13.30	J. M. Wills On densest packings of 3-spheres	J.-P. Bode Hexagonal achievement games	A. Betten Symmetric configurations v_3 and their automorphism groups	H.-D. Gronau Orthogonale Doppelüberdeckungen von Graphen	I. Fabrici On vertex-degree restricted subgraphs in 3-connected planar graphs
14.00	B. Wegner Full equi-intersectors in Euclidean and spherical geometry	M. Seemann Handicap achievement for square animals	H. Gropp 100 years of spatial configurations	R. Klimmek Small cycle decompositions and small cycle double covers of graphs	S. Jendroľ Light subgraphs in planar graphs
14.30	V. Soltan Non-extendable laces and loops of congruent circles in the plane	T. Andreae A two-person game on graphs where each player tries to encircle his opponent's men	S.L. Bezrukov Edge-isoperimetric inequalities for products of regular graphs	U. Schumacher Suborthogonal double covers by complete bipartite graphs	E. Harzheim Über das Differenzensystem von endlichen Mengen ganzer Zahlen
15.00	D. Betten The proper linear spaces on ≤ 18 points	M. Harborth Independence and domination on triangle game boards	T. Tautenhahn On the number of qualitatively different job shop problems	A. Huck Reducible configurations for the CDC-conjecture	A. Winterhof On Waring's problem in finite fields
15.30			**Kaffeepause**		
16.00	K. Dohmen Eine neue Variante des Prinzips der Inklusion-Exklusion	V.B. Balakirsky Asymptotics of the maximal number of almost cancellative subsets of an n-set	H.-J. Voß Sachs triangulations and regular hypermaps	J. Gustedt Sparseness of minor-closed graph classes revisited	U. Tamm Pascal-like triangles in the enumeration of trees and sequences
16.30	W. Oberschelp Ein Bijektionsbeweis für die Euler-Stirling-Identität	U. Krüger Über die Seitenstruktur von Polymatroiden auf teilweise geordneten Mengen	S. Böcker Recovering symbollically dated, rooted trees from ultrametric-like maps	R. Diestel Graph minors: from n to ω — eine unendliche Geschichte	T.-K. Strempel On the enumeration of (symmetrical) combinatorial structures

Raumplan

Hauptvorträge	:	Hörsaal PK 4.3 (Altgebäude, Pockelsstraße 4)
Sektionsvorträge	:	Hörsäle PK 14.3 und PK 14.4 (Forum, 3. Stockwerk) Hörsäle PK 14.6, PK 14.7 und PK 14.8 (Forum, 5. Stockwerk)
Tagungsbüro	:	F 314 (Forum, Pockelsstraße 14, 3. Stockwerk)
Bibliothek	:	F 416 (Forum, 4. Stockwerk)
Cafeteria	:	F 314/315 (Forum, 3. Stockwerk)
Arbeitsraum	:	F 507 (Forum, 5. Stockwerk)
Fernsprecher	:	Erdgeschoß des Forumsgebäudes; Altgebäude, in der Nähe des Hörsaales PK 4.3; Pockelsstraße, gegenüber der Universitätsbibliothek (Münz- und Kartenfernsprecher)

Öffnungszeiten von Tagungsbüro, Bibliothek, Cafeteria und Arbeitsraum: Freitag, 9^{00}–19^{00}h; Sonnabend, 9^{00}–18^{00}h.



1 Forum, Pockelsstraße 14
2 Altgebäude, Pockelsstraße 4
3 Mensa, Katherinenstraße 1
4 Gaußdenkmal
5 Mephisto, Fallersleberstraße 35, 15:00–3:00

6 Ana (Türkisch), Hamburger Straße 287, 10:00–1:00
7 Dialog (Bistro), Rebenring 48, 11:30–24:00
8 Eusebia (Bistro), Spielmannstraße 11, 9:00–2:00
9 Griechische Taverne, Rebenring 8a, 12:00–14:30, 17:30–0:00
10 Konfuzius (Chinesisch), Bültenweg 81, 11:30–15:00, 18:00–23:30
11 Lindenhof (Italienisch), Kasernenstraße 20, 11:30–15:00, 18:00–23:00
12 R. P. McMurphy (Irisch Pub), Bültenweg 10, 16:00–2:00
13 Pico's Bierladen (Türkisch), Bültenweg 6, 12:00–24:00
14 See Palast (Chinesisch), Gliesmaroderstraße 15, 11:30–15:00, 18:00–23:00
15 Teratai House (Indon.–Chin.), Wendenstraße 49/50, 12:00–15:00, 18:00–23:00
16 Viertel Nach (Bistro), Bültenweg 89, 9:00–2:00

GEMEINSAMES ABENDESSEN

Restaurant "Zum Burglöwen" im Hotel Deutsches Haus

Freitag, 14. November 1997, 19.30 Uhr

Unser gemeinsames Abendessen findet im Restaurant "Zum Burglöwen" im Hotel Deutsches Haus statt. Das Restaurant liegt im Zentrum der Stadt, nur wenige Gehminuten von den Hotels und der TU entfernt. Wir verbürgen uns für einen reibungslosen Ablauf des Abendessens und für einen netten Abend.

Sie haben die Wahl zwischen zwei Menüs. Entscheiden Sie sich für Menü 1 (Schweinenackenbraten), so erhalten Sie am Ende der Freitags-Vormittagssektion am Ausgang des Hörsaals einen gelben Bon. Bei Wahl von Menü 2 (Seezungenfilet) erhalten Sie einen blauen Bon. "Bon-Besitzer" genießen bei der Abendessenbedienung eine bevorzugte Behandlung.

HOTEL DEUTSCHES HAUS

Ringhotel Braunschweig

Veltenhöfer Bauernsuppe

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Schweinenackenbraten „Braunschweiger Art"
mit Birnenspalten in Braunbiersauce
Rosenkohl und Macaire-Kartoffeln
DM 30,00

oder

Seezungenfilets in Butter gebraten
mit Gemüsejuliennnen überzogen
Pariser Kartoffeln
DM 40,00

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Braunschweiger Rote Grütze
mit flüssiger Sahne

Freitag, den 14. November 1997

Stilvoll gepflegte Atmosphäre
im historischen Herzen
Braunschweigs

Hauptvorträge

O. Favaron (Paris, Frankreich)	:	Various concepts in domination theory
W. Mader (Hannover, Deutschland)	:	Topological subgraphs in graphs of given average degree
G. Sabidussi (Montréal, Kanada)	:	Colouring problems for 4-regular Hamiltonian graphs
W.T. Trotter (Tempe, AZ, USA)	:	Open problems in dimension theory for partially ordered sets

Kurzvorträge

J.-P. Allouche (Paris, Frankreich)	:	Lexicographically extremal overlap-free binary sequences
T. Andreae (Hamburg)	:	A two-person game on graphs where each player tries to encircle his opponent's men
V.B. Balakirsky (Bielefeld)	:	Asymptotics of the maximal number of almost cancellative subsets of an n-set
A. Betten (Bayreuth)	:	Symmetric configurations v_3 and their automorphism groups
D. Betten (Kiel)	:	The proper linear spaces on ≤ 18 points
S.L. Bezrukov (Paderborn)	:	Edge-isoperimetric inequalities for products of regular graphs
G. Blind (Stuttgart)	:	Schälungen und das Lower Bound Theorem
R. Blind (Stuttgart)	:	Schälungen und das Lower Bound Theorem
J.-P. Bode (Braunschweig)	:	Hexagonal achievement games
S. Böcker (Bielefeld)	:	Recovering symbollically dated, rooted trees from ultrametric-like maps
T. Böhme (Ilmenau)	:	On a modification of Hall's Theorem
S. Brandt (Berlin)	:	9-connected claw-free graphs are Hamilton-connected
G. Brinkmann (Bielefeld)	:	Small critical graphs
R. Diestel (Chemnitz)	:	Graph minors: from n to ω — eine unendliche Geschichte
K. Dohmen (Berlin)	:	Eine neue Variante des Prinzips der Inklusion-Exklusion
I. Fabrici (Ilmenau)	:	On vertex-degree restricted subgraphs in 3-connected planar graphs
S. Felsner (Berlin)	:	Triangles in Euclidean arrangements
C. Gröpl (Berlin)	:	Size and structure of ordered binary decision diagrams for random boolean functions
H.-D. Gronau (Rostock)	:	Orthogonale Doppelüberdeckungen von Graphen
H. Gropp (Heidelberg)	:	100 years of spatial configurations
M. Grüttmüller (Rostock)	:	Construction of pairwise balanced designs
Y. Guo (Aachen)	:	A new sufficient condition for a digraph to be Hamiltonian
J. Gustedt (Berlin)	:	Sparseness of minor-closed graph classes revisited
F. von Haeseler (Bremen)	:	A method to identify ultimately periodic p-automatic sequences
J. Harant (Ilmenau)	:	On dominating sets and independent sets of graphs
M. Harborth (Magdeburg)	:	Independence and domination on triangle game boards
S. Hartmann (Rostock)	:	Blowing up graphs
E. Harzheim (Düsseldorf)	:	Über das Differenzensystem von endlichen Mengen ganzer Zahlen
H. Hassenpflug (Aachen)	:	Multivariate sequences generated by finite data
F. Havet (Lyon, Frankreich)	:	Trees in tournaments
W. Hochstättler (Köln)	:	Large circuits in binary matroids of large cogirth
M. Hoeth (Braunschweig)	:	Ramsey numbers for graphs of order four versus connected graphs of order six
A. Huck (Hannover)	:	Reducible configurations for the CDC-conjecture
S. Jendrol̃ (Kosiče, Slowakei)	:	Light subgraphs in planar graphs
P. Johann (Aachen)	:	A grouptesting problem for graphs with several defective edges
R. Klimmek (Berlin)	:	Small cycle decompositions and small cycle double covers of graphs
E. Köhler (Berlin)	:	On the recognition of asteroidal triple-free graphs
M. Kriesell (Berlin)	:	Contractible subgraphs in 3-connected graphs
U. Krüger (Halle)	:	Über die Seitenstruktur von Polymatroiden auf teilweise geordneten Mengen
N. Kuzjurin (Moskau, Rußland)	:	Almost optimal explicit constructions of asymptotically good packings

W. Lang (Karlsruhe)	:	Counting walks on Jacobi-graphs: an application of orthogonal polynomials
V.B. Le (Rostock)	:	Recognizing perfect 2-split graphs
U. Leck (Rostock)	:	On subword orders
V. Leck (Rostock)	:	Nonisomorphic drawings of graphs
H. Mielke (Berlin)	:	The Penrose polynomial
E.N. Müller (Berlin)	:	Kreuzkorrelation linearer Schieberegisterfolgen
V. Nalivaiko (Magdeburg)	:	The constructive facet-generating methods for the linear ordering polytope
T. Niessen (Aachen)	:	Polyhedral description of multicolorings
W. Oberschelp (Aachen)	:	Ein Bijektionsbeweis für die Euler-Stirling-Identität
T. Pisanski (Ljubljana, Slowenien)	:	Haar graphs
S.P. Radziszowski (Rochester, USA)	:	Computation of the Folkman Number $F(3,3;5)$
B. Randerath (Aachen)	:	A Vizing-type bound for the chromatic number
D. Rautenbach (Aachen)	:	On the differences between the upper irredundance, upper domination and independence numbers of a graph
Z. Ryjacek (Pilsen, Tschechische Republik)	:	Closure and stable properties in claw-free graphs
H. Sachs (Ilmenau)	:	On a strange observation in the theory of the dimer problem
I. Schiermeyer (Cottbus)	:	On extremal problems concerning weights of edges of graphs
R.-H. Schulz (Berlin)	:	On check digit systems with error correction
U. Schumacher (Rostock)	:	Suborthogonal double covers by complete bipartite graphs
M. Seemann (Braunschweig)	:	Handicap achievement for square animals
V. Soltan (Chemnitz)	:	Non-extendable laces and loops of congruent circles in the plane
M. Sonntag (Freiberg)	:	Zu Maximalstromalgorithmen in geschichteten Transportnetzen
E. Sparla (Stuttgart)	:	On upper bound conjectures for combinational pseudo-k-manifolds
T.-K. Strempel (Darmstadt)	:	On the enumeration of (symmetrical) combinatorial structures
U. Tamm (Bielefeld)	:	Pascal-like triangles in the enumeration of trees and sequences
T. Tautenhahn (Magdeburg)	:	On the number of qualitatively different job shop problems
H.-M. Teichert (Lübeck)	:	Zur Summenzahl von Hypergraphen
M. Tewes (Aachen)	:	Vertex pancyclic digraphs
S. Thomasse (Lyon, Frankreich)	:	Paths in tournaments, a proof of Rosenfeld's conjecture
E. Triesch (Aachen)	:	The subgraph degree polytope
S. Urbański (Poznań, Polen)	:	Vertex-Folkman numbers
H.-J. Voß (Dresden)	:	Sachs triangulations and regular hypermaps
B. Wegner (Berlin)	:	Full equi-intersectors in Euclidean and spherical geometry
B. Weißbach (Magdeburg)	:	Ein weiteres Gegenbeispiel zur Borsukschen Vermutung
J. M. Wills (Siegen)	:	On densest packings of 3-spheres
A. Winterhof (Braunschweig)	:	On Waring's problem in finite fields

Weitere Teilnehmer

U. Baumann (Dresden), P. Braß (Berlin), W. Deuber (Bielefeld), T. Dinski (Bielefeld), D. Dornieden (Braunschweig), D. Gernert (München), E. Girlich (Magdeburg), R. Halin (Hamburg), H. Harborth (Braunschweig), M. Höding (Magdeburg), T. Jensen (Chemnitz), L.K. Jørgensen (Aalborg, Dänemark), C. Josten (Frankfurt), H.A. Jung (Berlin), A. Kemnitz (Braunschweig), J. Kind (Aachen), W. Kühnel (Stuttgart), R. Labahn (Rostock), G. Laßmann (Berlin), H. Lefmann (Dortmund), H. Lenz (Berlin), R. Löwen (Braunschweig), I. Mengersen (Braunschweig), K. Metsch (Giessen), U. Minne (Berlin), M. Möller (Braunschweig), D. Olpp (München), A. Piepenburg (Hannover), K. Piwakowski (Gdańsk, Polen), J. Quistorff (Hamburg), T. Schoen (Poznań, Polen), P. Stark (Braunschweig), M. Stiebitz (Ilmenau), C. Thürmann (Braunschweig), Z. Tuza (Budapest, Ungarn), M. Voigt (Ilmenau), L. Volkmann (Aachen), K. Waas (Chemnitz), H. Weiß (Braunschweig), P. Willenius (Magdeburg), G. Zesch (Berlin)

Lexicographically extremal overlap-free binary sequences

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A sequence over an alphabet (finite set) A is said *overlap-free* if it does not contain any factor $axaxa$ where a is a letter in A, and x a word on A. The study of infinite overlap-free binary sequences goes back to Thue (1906) who proved that the sequence (now known as the Thue-Morse sequence) obtained by iterating the morphism $0 \to 01$, $1 \to 10$, is overlap-free.
Actually this sequence is somehow *the* binary overlap-free sequence. For example it has been proved by Berstel and Séébold that a binary sequence that is a fixed point of a morphism is necessarily the Thue-Morse sequence or its complement. We study here (joint work with Currie and Shallit) the lexicographically least overlap-free sequences that begin with a given finite word. Our main result is that such a sequence *has an infinite suffix that is equal to a suffix of the complement of the Thue-Morse sequence. In particular such a sequence is* 2-automatic.

A Two–Person Game on Graphs where each Player tries to Encircle his Opponent's Men

THOMAS ANDREAE*, FELIX HARTENSTEIN, ANDREA WOLTER

Universität Hamburg

We present results on a combinatorial game which was proposed to one of the authors by Ingo Althöfer. Let G be an undirected finite graph without loops and multiple edges and let k be a positive integer, $k \leq \frac{|G|-1}{2}$. There are two players, called *white* and *black*, both having k men of their color. In turn, beginning with white, the players position their men one at a time on unoccupied vertices of G. When all men are placed, the players take turns moving a man of their color along an edge to an unoccupied adjacent vertex (again beginning with white). A player *wins* if his opponent cannot carry out his next move since none of his men has an unoccupied neighbor. If the game does not stop, then the outcome is a *draw*. We always assume that both players play optimal. Let $\tau(G)$ denote the *covering number* of G, i. e., $\tau(G)$ is the minimum number of vertices covering all edges of G. We prove that black wins the game if $\tau(G) \leq k$. We use this result to show that white never wins the game if G is bipartite. We also construct an infinite series of trees for which the outcome is a draw. Moreover, we present results on extremal problems arising in the context of the game. We also completely solve the cases when G is a path or a cycle. Further, we completely settle the case $k \leq 2$. In the proofs of our results, matchings and cycles in graphs play a predominant role.

Asymptotics of the Maximal Number of Almost Cancellative Subets of an n-Set

VLADIMIR B. BALAKIRSKY
FAKULTÄT FÜR MATHEMATIK, UNIVERSITÄT BIELEFELD,
POSTFACH 100131, D-33501 BIELEFELD 1

A family of subsets of a set $\{1,\ldots,n\}$ is called a cancellative family if based on a union of any pair of subsets and one of the entries of the union we can uniquely determine another entry. If M_n is the maximal number of subsets with this property, then the following result is known: $\lim_{n\to\infty}(\log_2 M_n)/n < \log_2 1.5 \approx 0.582$. We introduce almost cancellative families in such a way that the cancellative property holds for at least $(1-\varepsilon)M^2$ pairs of subsets (M is the number of subsets and $\varepsilon > 0$). We prove that $\inf_{\varepsilon>0}\lim_{n\to\infty}(\log_2 M_n(\varepsilon))/n = \max_{0\leq\gamma\leq 1}\gamma h(\gamma) \approx 0.617$, where $M_n(\varepsilon)$ is the maximal size of almost cancellative families constructed for a given ε and $h(\gamma) = -\gamma\log_2\gamma - (1-\gamma)\log_2(1-\gamma)$ is the binary entropy function.

Symmetric Configurations v_3 and their Automorphism Groups

ANTON BETTEN
Lehrstuhl II für Mathematik
Universität Bayreuth
email: Anton.Betten@uni-bayreuth.de

Configurations are a very general concept in incidence geometry. They appear naturally when points, blocks or even flags are stabilized in Steiner Systems e.g. 2-designs with $\lambda = 1$. Linear Spaces can be decomposed into configurations. Regular Linear Spaces can be seen as a collection of configurations stacked upon each other on the same point set.
Using a computer search, GUNNAR BRINKMANN and the speaker computed symmetric configurations v_3 for $v \leq 18$ (with two independently written programs) up to isomorphism.
A lot of properties of configurations deal with the automorphism group. Therefore, self-duality, self-polarity, transitivity on points, blocks and flags and more are computed and will be discussed in the talk.

The Proper Linear Spaces on ≤ 18 Points

DIETER BETTEN
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24098 Kiel
betten@math.uni-kiel.de

A linear space is called proper if each line contains at least three points and if there exist at least two lines. All proper linear spaces on up to 18 points are classified. A new method of computation is developed which refines and generalizes previous concepts. It is based on the parameters of geometries and has partially been applied during the construction of linear spaces on 12 points, for example. This new method -called TDO method – is explained and illustrated by various examples.

Edge-Isoperimetric Inequalities for Products of Regular Graphs

S.L. BEZRUKOV, R. ELSÄSSER
Fachbereich Mathematik/Informatik
Universität-GH Paderborn

Let G be a k-regular graph and let G^n be the n^{th} cartesian power of G. For a given m, $1 \leq m \leq |V_{G^n}|$, consider the problem of constructing a set $A \subseteq V_{G^n}$ with $|A| = m$, such that the size of the edge-cut separating A from its complement in G^n is minimal among all m-subsets of V_{G^n}. We present lower bounds for the size of this cut in the case $k \geq |V_G|/2$, and show that they are best possible. Our approach is also applicable for the products of bipartite regular graphs of large degree.

Schälungen und das Lower Bound Theorem

G. Blind und R. Blind

Für ein simpliziales d-Polytop P mit gegebener Eckenzahl n gibt das Lower Bound Theorem (LBT) eine scharfe untere Schranke an für die Anzahl $f_k(P)$ der k-Seiten von P $(1 \leqslant k \leqslant d-1)$: Es ist $f_k(P) \geqslant \varphi_k(n,d)$, wobei $\varphi_k(n,d)$ die Anzahl der k-Seiten eines d-dimensionalen "Stapelpolytops" mit ebenfalls n Ecken ist. Im Fall $d \geqslant 4$ folgt aus der Gleichheit für irgendein k, $1 \leqslant k \leqslant d-1$, daß P selbst Stapelpolytop ist.

Das LBT wurde 1973 von Barnette bewiesen, der Gleichheitsfall allerdings nur für $k = d-1$. Später wurde der Gleichheitsfall auch für die anderen k bewiesen, und das LBT wurde auf Mannigfaltigkeiten und Pseudomannigfaltigkeiten verallgemeinert, aber es fehlt noch immer ein elementarer Beweis des LBT einschließlich des Gleichheitsfalles für jedes k.

Mit Hilfe von Schälungen erhalten wir einen solchen elementaren Beweis des LBT einschließlich Gleichheitsfall für simpliziale Polytope.

Hexagonal Achievement Games

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In a tessellation as game board, the cells are alternately marked by players A and B. A given polyomino P is called a winner if A can achieve P in his marks regardless of the moves of B. Otherwise it is called a loser. For the hexagonal tessellation all but one of the polyominoes with at most five cells are determined as winners or losers. There are winners with six cells. The handicap number of a polyomino is defined as the smallest number of cells which the first player A has to mark before the game starts with the first move of A, and such that there exists a winning strategy for A. A graphical method to prove an upper bound for the handicap number of a polyomino is presented.

Recovering symbolically dated, rooted trees from ultrametric-like maps

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A well known result from cluster theory states that there is a 1-to-1 correspondence between dated, compact, rooted trees and ultrametrics. In the lecture, this result will be generalized yielding a 1-to-1 correspondence between symbolically dated trees and symbolic ultrametrics using an arbitrary set as the set of (possible) dates or values. It turns out that a rather unexpected new condition is needed to define symbolic ultrametrics. As an application, a new proof of a theorem by H. J. Bandelt and M. A. Steel is given regarding the 1-to-1 correspondence between additive trees and metrics satisfying the 4-point condition, both taking their values in abelian monoids.

On a Modification of Hall's Theorem

THOMAS BÖHME (ILMENAU, GERMANY)
AND
ZSOLT TUSZA (BUDAPEST, HUNGARY)

The following problem is considered. Let X and Y be non-empty finite sets, and let

$$\Phi : X \longrightarrow 2^{2^Y}$$

be a mapping from X into the power-set of the power-set of Y. Does there exist a mapping

$$\varphi : X \longrightarrow 2^Y$$

such that (a) $\varphi(x) \in \Phi(x)$ for every $x \in X$, and (b) $\varphi(x) \cap \varphi(y) = \emptyset$ whenever $x_1 \neq x_2$?

9-connected claw-free graphs are Hamilton-connected

STEPHAN BRANDT
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In 1991, Zhan proved that every 7-connected line graph is Hamilton-connected, i.e., every pair of vertices is joined by a hamiltonian path. For the superclass of claw-free graphs it was not even known, whether any constant k exists such that every k-connected claw-free graph is hamiltonian, until very recently Ryjáček developed a closure concept turning a claw-free graph into a line graph and leaving the length of a longest cycle unchanged. By Zhan's result this implies that 7-connected claw-free graphs are hamiltonian. Unfortunately, the length of a longest path between a pair of vertices may change in the closure process, so it cannot be concluded, that 7-connected claw-free graphs are Hamilton-connected.
In the talk, a natural reformulation of Ryjáček's closure concept will be presented, which is technically easier to handle. This will be used to prove that 9-connected claw-free graphs are Hamilton-connected.

Small Critical graphs

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Abstract

A graph G is called *colourable*, if its edges can be coloured with Δ colours - Δ being the maximum degree of the graph. A graph G is called *critical*, if it is uncolourable, but the removal of any of its edges leads to a colourable graph. A critical graph G on n vertices is non-trivial if it has at most $\Delta\lfloor\frac{n}{2}\rfloor$ edges.

We prove that there is no chromatic-index-critical graph of order 12, and that there are precisely two non-trivial chromatic index critical graphs on 11 vertices. The proof works by reducing the number of degree sequences that have to be checked by hand and checking the remaining sequences with the help of a computer.

Together with known results this implies that there are precisely three non-trivial critical graphs of order ≤ 12 and that the smallest counterexample to the critical graph conjecture has at least 14 and at most 18 vertices.

Graph Minors: from n to ω—eine unendliche Geschichte

Reinhard Diestel & Robin Thomas

The Robertson-Seymour K_n structure theorem says that every graph G without a K_n minor has a tree-decomposition over graphs which, after the deletion of a bounded number of vertices, can be embedded in one of a bounded number of closed surfaces with a bounded number of holes, in such a way that the outgrowth at the boundary of each hole—its *vortex*—has bounded width. Here, *bounded* means 'depending on n, but not on G'. The theorem is pivotal in Robertson & Seymour's proof of their *Minor Theorem* (that the finite graphs are wqo): disregarding, as we may, all those bounded irregularities (as well as tree structure), what remains to prove is that the graphs embeddable in any fixed surface S are wqo. This can be done by induction on the genus of S, using standard surface surgery.

Whether or not the minor theorem extends to countable graphs is a major open problem. Any proof along the lines above would benefit from similar structure theorems for infinite graphs without K_n, or K_ω (the countably infinite complete graph), as a minor.

We present two such theorems: the extension of Robertson-Seymour's K_n structure theorem to infinite graphs, and a structure theorem for K_ω. The latter uses the former in its proof, but its assertion turns out to be much simpler (as well as best possible, unlike the K_n theorem): *a graph has no infinite complete minor if and only if it has a tree-decomposition over plane graphs with at most one vortex.*

Eine neue Variante des Prinzips der Inklusion-Exklusion

KLAUS DOHMEN
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Sei $(\Omega, \mathcal{A}, \Pr)$ ein Wahrscheinlichkeitsraum und $(A_p)_{p \in P}$ eine endliche Familie von Ereignissen, deren Indexmenge P mit einer Halbordnung versehen ist. Weiter sei $\mathfrak{X}$ eine Menge von nichtleeren Teilmengen von P, so daß für alle $X \in \mathfrak{X}$ gilt:

$$\Pr\left(\bigcup_{x \in X'} A_x \,\middle|\, \bigcap_{x \in X} A_x\right) = 1,$$

wobei X' die Menge der nicht in X enthaltenen oberen Schranken von X sei. Wir zeigen, daß

$$\Pr\left(\bigcup_{p \in P} A_p\right) = \sum_{\substack{I \subseteq P,\, I \neq \emptyset, \\ I \not\supseteq X \forall X \in \mathfrak{X}}} (-1)^{|I|-1} \Pr\left(\bigcap_{i \in I} A_i\right)$$

und stellen verschiedene Anwendungen dieses Resultats vor. Diese betreffen u.a. chromatische Polynome, Permanenten von 0, 1-Matrizen und Zuverlässigkeitsbewertungen von Netzstrukturen.

On vertex-degree restricted subgraphs in 3–connected planar graphs

IGOR FABRICI, Technische Universität Ilmenau

Abstract

Every 3–connected planar graph G on at least k vertices ($k \geq 4$) with $\delta(G) \geq 4$ contains a connected subgraph H on (exactly) k vertices having degree (in G) at most $4k - 1$; the bound $4k - 1$ is the best possible.

Various concepts in domination theory

Odile Favaron

During the last 30 years, the concept of domination has raised an impressive interest. A recent bibliography on the subject contains more than 1200 references and the number of new definitions is continually increasing. Rather than trying to give a catalogue of all of them, we survey the most classical and important notions (as independent domination, irredundant domination, k-coverings, k-dominating sets, fractionnal domination, ...) and results.

Triangles in Euclidean Arrangements

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Abstract. In 1926 Levi proved that a nontrivial arrangement -simple or not- of n pseudolines in the projective plane contains n triangles. To show the corresponding result for the Euclidean plane, namely, that a simple arrangement of n pseudolines contains $n-2$ triangles, a completely different proof was required. On the other hand a non-simple arrangements of n pseudolines in the Euclidean plane can have as few as $2n/3$ triangles and this bound is best possible. We also discuss the maximal possible number of triangles and some extensions.

Über orthogonale Doppelüberdeckungen von Graphen

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Eine *orthogonale Doppelüberdeckung* des K_n durch einen Graphen G ist eine Menge $\{G_1, G_2, \ldots, G_n\}$ von zu G isomorphen Graphen, für die gilt:
(i) Jede Kante des K_n kommt in genau zwei G_i's vor.
(ii) Je zwei G_i's haben genau eine Kante gemeinsam.
Das generelle Problem ist die Bestimmung aller Paare (G, n), für die es eine orthogonale Doppelüberdeckung des K_n durch G gibt. Im Vortrag werden einige neue Ergebnisse vorgestellt.

Size and Structure of Ordered Binary Decision Diagrams for Random Boolean Functions

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We investigate the size and structure of ordered binary decision diagrams (OBDDs) for random Boolean functions. Wegener (1994) showed that for "most" values of n, the expected OBDD-size of a random Boolean function with n variables equals the worst-case size up to terms of lower order. We prove that this phenomenon, also known as strong Shannon effect, has a threshold behaviour: The strong Shannon effect *does not* hold within intervals of constant width around the values $2^h + h$, $h \to \infty$, but it *does* hold for sequences that avoid these intervals. We also identify those n for which the gap between the expected and the worst-case size is minimal, and describe the oscillation of the expected and the worst-case size in between. Methodical innovations of our approach are a functional equation to locate a "critical level" in OBDDs and the use of Azuma's martingale inequality and Chvátal's large deviation inequality for the hypergeometric distribution, which lead to significant improvements over Wegener's probability bounds.

100 years of spatial configurations

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Spatial configurations were already defined and investigated in 1897 by V. Martinetti. A spatial configuration or 2-configuration $(v_r, b_k)_2$ consists of v points and b lines such that there are k points on each line, r lines through each point, and two different points are connected by at most 2 lines. Here only symmetrical spatial configurations $(v_k)_2$ are discussed where $v = b$ and $r = k$. A particular subclass are biplanes where through two points there are exactly 2 lines. In his paper of 1897 Martinetti started the systematical research by constructing all 2-configurations $(8_4)_2$. In this talk the current state of knowledge is described concerning the existence of 2-configurations for values of $k \leq 7$.

References: H. Gropp, Discrete math. 125 (1994), 201-209 and H. Gropp, Mathematica Slovaca 42 (1992), 517-529.

Construction of Pairwise Balanced Designs

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Let K be a set of positive integers. Then a *pairwise balanced design* ($PBD[v, K]$) of order v with block sizes from K is a pair $(V, \mathcal{B})$, where V is a finite set (the *point set*) of cardinality v and $\mathcal{B}$ is a family of subsets (called *blocks*) of V which satisfy the following properties:
(i) if $B \in \mathcal{B}$, then $|B| \in K$;
(ii) every pair of distinct elements of V occurs in exactly one block of $\mathcal{B}$.

In this talk we describe a random algorithm (Hill-climbing) for constructing PBD's which contain blocks of size 3. Starting with all blocks of size unequal 3 (the *prestructure*) the Hill-climbing approach supplies blocks of size 3 to obtain a PBD. Furthermore we will consider construction of prestructures.

A new sufficient condition for a digraph to be Hamiltonian

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The following extension of Meyniels theorem was conjectured by Bang–Jensen, Gutin and Li: If D is a digraph on n vertices with the property that $d(x) + d(y) \geq 2n - 1$ for every pair of non-adjacent vertices x, y with a common out-neighbour or a common in-neighbour, then D is Hamiltonian. We verify the conjecture in the special case where we also require that $\min\{d^+(x) + d^-(y), d^-(x) + d^+(y)\} \geq n - 1$ for all pairs of vertices x, y as above. This generalizes one result from Bang–Jensen, Gutin and Li. Furthermore we provide additional support for the conjecture above by showing that such a digraph always has a factor (a spanning collection of disjoint cycles). Finally we show that if D satisfies that $d(x) + d(y) \geq \frac{5}{2}n - 4$ for every pair of non-adjacent vertices x, y with a common out-neighbour or a common in-neighbour, then D is Hamiltonian.

Sparseness of Minor-Closed Graph Classes Revisited

JENS GUSTEDT
Technische Universität Berlin

A classical result of Mader states that for every r there is some h_r such that every graph G with average degree at least h_r contains K_r as a topological minor. As an immediate consequence we have that for any non-trivial minor-closed graph class C there is a value u_C such that all simple graphs in C have average degree at most u_C. This sparseness of graphs in minor-closed graph classes can be very useful for the design of algorithms since it guarantees that any sequence of k contractions in a graph $G \in C$ and subsequent deletion of loops and parallel edges will result in a graph that has $|V(G)| - k$ vertices and must thus have less than $u_C|V(G)|$ edges.
This principle allows for many sequential algorithms to run in *linear time*. Suppose we are able to repeatedly contract $\varepsilon|V(G)|$ edges and delete all necessary edges to obtain again a simple graph. Then the alternation of contraction and deletion phases gives a total number of contractions and deletions that is bounded by $\frac{u_C|V(G)|}{1-\epsilon}$ and thus linear in the size of G. For *parallel* algorithms it is not so easy to use this feature, since there is no straight forward method to do the deletions with reasonable cost. In this talk we will show that the graphs in question can be recursively divided into levels and how this can be used that edges find sufficiently many duplicates in their neighborhood in the adjacency list.

A Method to identify ultimately periodic p-automatic sequences

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CeVis Universität Bremen

It is a well known fact that any ultimately periodic sequence with values in a finite set is k-automatic for all $k \geq 2$. In other words, any ultimately period sequence is recognizable by a finite k-automaton, or, equivalently, is generated by a constant length substitution. In 1978, F.M. Dekking (Z. Wahrscheinlichkeitstheorie **41** (1978), 221-239) presented a necessary and sufficient condition for a fixed point of a constant length substitution to be periodic.

In the talk, we introduce the kernel graph of an automatic sequence. The kernel graph provides a tool to decide whether the sequence is ulimately periodic or not. We present a necessary and sufficient condition for the kernel graph to represent a ultimately periodic sequence.

On Dominating Sets and Independent Sets of Graphs

Jochen Harant, Technical University of Ilmenau

For a graph G on its vertex-set $V = \{1, ..., n\}$ let $\mathfrak{k} = (k_1, ..., k_n)$ be an integral vector such that $1 \leq k_i \leq d_i$ for $i \in V$, where d_i is the degree of the vertex i in G. A $\mathfrak{k}$-dominating set is a set $D_{\mathfrak{k}} \subseteq V$ such that every vertex $i \in V \backslash D_{\mathfrak{k}}$ has at least k_i neighbours in $D_{\mathfrak{k}}$. The $\mathfrak{k}$-domination number $\gamma_{\mathfrak{k}}(G)$ of G is the cardinality of a smallest $\mathfrak{k}$-dominating set of G. For $k_1 = ... = k_n = 1$, $\mathfrak{k}$-domination corresponds to the usual concept of domination. Our approach yields an improvement of an upper bound for the domination number found by N. Alon and J.H. Spencer. If $k_i = d_i$ for $i = 1, ..., n$, then the conception of $\mathfrak{k}$-domination leads to results for the independence number of a graph. A function $f_{\mathfrak{k}}(\mathfrak{p})$ is defined, and it will be proved that $\gamma_{\mathfrak{k}}(G) = \min f_{\mathfrak{k}}(\mathfrak{p})$, where the minimum is taken over the n-dimensional cube $\mathbf{C}^n = \{\mathfrak{p} = (p_1, ..., p_n) \mid p_i \in \mathbb{R}, 0 \leq p_i \leq 1, i = 1, ..., n\}$. An $\mathcal{O}(\Delta^2 2^\Delta n)$-algorithm is presented, where Δ is the maximum degree of G, with INPUT: $\mathfrak{p} \in \mathbf{C}^n$ and OUTPUT: a $\mathfrak{k}$-dominating set $D_{\mathfrak{k}}$ of G with $|D_{\mathfrak{k}}| \leq f_{\mathfrak{k}}(\mathfrak{p})$.

Independence and Domination on Triangle Game Boards

Martin Harborth
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A triangle game board is a hexagonal board with congruent triangles as cells. In analogy to square boards $B_n(4)$, the triangle game board $B_n(3)$ consists of one triangle (one point) surrounded by $\lfloor n/2 \rfloor$ rings of neighboring triangles if n is even (odd). In this notation the board $B_8(4)$ is the well-known chessboard.

Independence and domination problems associated with the placement of chess pieces on chessboards have been studied widely. However, less is known about these problems on generalized chess boards. We consider independence and domination problems on triangle game boards for various chess-like pieces.

Blowing up Graphs

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Let $\mathcal{G}$ be a given graph with vertex set V and edge set E.

¿From $\mathcal{G}$ we obtain a new graph $\mathcal{H}$ by blowing up $\mathcal{G}$, i.e. by replacing each original vertex v in $\mathcal{G}$ by a class $\phi(v)$ of new vertices as well as each original edge e in $\mathcal{G}$ by a class $\phi(e)$ of some new edges between vertices from the corresponding classes in $\mathcal{H}$. Hence, $\mathcal{G}$ is just the homomorphic image of $\mathcal{H}$ under the mapping ϕ^{-1}.

We are interested in such graphs $\mathcal{H}$ which satisfy certain conditions on their vertex degrees. In particular, we want the degree of every vertex w in a fixed class $\phi(v)$ to be bounded by two given constants $a(v)$ and $b(v)$:

$$a(v) \leq deg_{\mathcal{H}}(w) \leq b(v).$$

We give necessary and sufficient conditions for the existence of such graphs $\mathcal{H}$ and discuss a number of variations of the original problem.

<u>HARZHEIM</u> : Über das Differenzensystem von endlichen Mengen ganzer Zahlen

Im Folgenden seien n,a,d natürliche Zahlen mit $n+1 \geq a \geq d > 0$. Ist A eine Menge von ganzen Zahlen aus $[0,n]$, so heißt ein $(x,y) \in A \times A$, wo $x < y$ sei, ein A-Paar mit der Distanz $y - x$.

Wir betrachten dann folgende Frage: Sei A eine Menge von a ganzen Zahlen des Intervalls $[0,n]$. Wieviele A-Paare (mindestens bzw höchstens) haben dann die Distanz d ?

Diese zwei Fragen werden komplett beantwortet mit jeweils scharfen Schranken.

Multivariate sequences generated by finite data

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"Solutions of recurrences with constant coefficients have rational generating functions."

This statement does not generalize to the multivariate case, because

$$\frac{e^x}{1-x-y}$$

is not a rational function in a narrow sense. If we do not like to become sad about this fact, we may observe that in the multivariate case sequences with rational generating functions form a subclass of all recurrent sequences, which is trivially closed under addition and convolution. A finite amount of data is sufficient to define a member of this class (if we assume that the members of the coefficient field have a finite representation), which makes those sequences accessible to computers. We discuss the question which "initial conditions" lead to rational generating functions and if there is a useful generalization to polynomial coefficients.

Trees in tournaments.

FRÉDÉRIC HAVET
Université Claude Bernard de Lyon

Let $f(n)$ be the smallest integer such that every tournament of order $f(n)$ contains every oriented tree of order n. And let $g(k)$ be the smallest integer such that every tournament of order $n+g(k)$ contains every oriented tree of order n. Sumner has just conjectured that $f(n) = 2n - 2$. Häggkvist and Thomason proved that $f(n) \leq 12n$ and $f(n) \leq (4 + o(1))n$. Furthermore they proved that $g(k) \leq n + 2^{512k^3}$.

With Stephan Thomassé, we conjecture that $g(k) \leq k - 1$. We prove here that $g(3) \leq 9$ and then that $f(n) \leq 7,6n$.

Large Circuits in Binary Matroids of Large Cogirth

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We extend two classical theorems about long circuits in graphs to regular matroids. The first result, due to Dirac, states that if G has minimum degree $d \geq |V|/2$, then G is hamiltonian. The second result, due to Erdös and Gallai, states that if $e = uv \in E(G)$ and every vertex of $V(G) - \{u, v\}$ has degree at least d, then G has a circuit C containing e and of size at least $d + 1$. The extension of Dirac's theorem was conjectured by D.J.A. Welsh, the extension of the Erdös-Gallai result generalises a result of Bixby and Cunningham that if M is a simple binary matroid with no F_7-minor and every cocircuit of M has size at least d, then $r(M) \geq d$.

(joint work with Bill Jackson, Goldsmiths' College, London)

Ramsey numbers for graphs of order four versus connected graphs of order six

MAIK HOETH
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The Ramsey numbers $r(G,H)$ have been studied for various small graphs G and H. For all (simple and undirected) graphs G and H of order at most five the values of $r(G,H)$ are known up to five cases.
We will begin to complete the table of values of $r(G,H)$ for all (isolate-free) graphs G of order at most four and all graphs H of order six. The cases $G = P_3$, $G = 2K_2$ and $G = K_3$ are already solved. For the remaining cases only some special numbers $r(G,H)$ have been determined as $r(K_4 - e, K_6 - e) = 17$. Here we will focus on $G = K_{1,3} + e$ and $G = K_4 - e$. The numbers $r(K_{1,3} + e, G)$ will be completely determined and the still missing values of $r(K_4 - e, G)$ up to $r(K_4 - e, K_6)$.

Reducible configurations for the cycle–double–cover–conjecture

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The well-known CDC–conjecture states that each bridgeless graph contains a k–CDC for some integer k, i.e. a system of k cycles covering each edge exactly twice (here a cycle is a subgraph in which each vertex has an even degree). In 1985, Goddyn proved that each circuit of length at most 6 is reducible for the CDC–conjecture (i.e. such a circuit cannot be contained in a minimal counterexample) so that each minimal counterexample has girth at least 7. We refine and schematize Goddyn=EFs method so that reducibility of graphs (not necessarily circuits) can be proved just by performing some verification algorithms. By implementing these algorithms on a computer, we can prove so far that each counterexample to the CDC–conjecture has girth at least 12. Moreover, each counterexample to the 5–CDC–conjecture (each bridgeless graph has a 5–CDC) has girth at least 10.

LIGHT SUBGRAPHS IN PLANAR GRAPHS

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and Institute of Mathematics, Slovak Academy of Sciences

Let $\mathcal{H}$ be a family of graph and let H be a graph which is isomorphic to a subgraph of at least one member of $\mathcal{H}$. Let $\varphi(H,\mathcal{H})$ be the *smallest integer* with property that every graph $G \in \mathcal{H}$ which has a subgraph isomorphic with H contains also a subgraph K, $K \cong H$, such that for every vertex $v \in V(K)$ there is

$$\deg_G(v) \leq \varphi(H,\mathcal{H}).$$

If such $\varphi(H,\mathcal{H})$ does not exist we write $\varphi(H,\mathcal{H}) = +\infty$. We shall say that the graph H is *light in the family* $\mathcal{H}$ is $\varphi(H,\mathcal{H}) < +\infty$.

We give a survey of recent results concerning light subgraphs in different families of planar graphs. For example a graph G is light in the family of all 3-connected planar graphs $\mathcal{P}$ if and only if G is a path P_k on k vertices, $k \geq 1$. Moreover, $\varphi(P_k, \mathcal{P}) = 5k$.

A grouptesting problem for graphs with several defective edges

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In their book *Combinatorial grouptesting and its applications* Du and Hwang considered the following generalization of classical grouptesting problems : Suppose a graph contains m edges d of which are defective. Find all defective edges by testing whether an induced subgraph contains a defective edge or not. They conjectured that this can be done by using at most

$$d\left(\log_2 \frac{m}{d} + c\right)$$

tests for some constant c. We prove this conjecture for $c = 9$.

Small Cycle Decompositions and Small Cycle Double Covers of Graphs

REGINA KLIMMEK (TU Berlin)

There is a conjecture by Hajós from the 60's that every eulerian graph of size n has a cycle decomposition into at most $\frac{n-1}{2}$ (simple) cycles. Analogously, Bondy conjectured in 1990 that every bridgeless graph has a cycle double cover by at most n-1 cycles.
Both conjectures seem to be very difficult to solve generally (Bondy's conjecture implies the Cycle double cover conjecture). Even an upper bound linear in n for the number of cycles needed for a decomposition/double cover could not yet be shown.
The two conjectures, however, are true for some classes of graphs. In this talk a survey of the partial results concerning these two conjectures will be given and chances for getting more general results will be discussed.

On the Recognition of Asteroidal Triple-Free Graphs

EKKEHARD KÖHLER, BERLIN

In recent years a class of graphs gained a lot of attention in the field of Algorithmic Graph Theory: The Asteroidal Triple Free Graphs. Although their creation dates back into the early sixties AT-free graphs were not properly studied until the beginning of the nineties.
In this talk we look at different algorithms for the recognition of AT-free graphs and at some kind of lower bound for the complexity of this problem. We introduce an auxiliary graph which is useful not only for AT-free graphs and enables us to create an elegant recognition algorithm.

Contractible subgraphs in 3-connected graphs

MATTHIAS KRIESELL, Berlin

A subgraph H of a 3-connected finite graph G is called *contractible* if H is connected and $G - V(H)$ is 2-connected. The talk is concerned with a conjecture of McCUAIG and OTA which states that for any natural number k there exists a natural number $f(k)$ such that any 3-connected graph on at least $f(k)$ vertices possesses a contractible subgraph on k vertices. We consider the case $k \leq 4$, and restrictions to maximal planar graphs, HALIN-graphs, and line graphs of 6-edge-connected graphs.

Über die Seitenstruktur von Polymatroiden auf teilweise geordneten Mengen

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Der Vortrag behandelt eine Verallgemeinerung von Polymatroiden auf teilweise geordnete Mengen. Insbesondere untersuchen wir, in welcher Weise sich Basispolytope von gewöhnlichen submodularen Systemen und Polymatroiden auf das allgemeinere Modell übertragen.

Es zeigt sich, daß die Seitenstruktur der betrachteten Polyeder günstig durch Partitionen der zugrundeliegenden teilweise geordneten Menge in Antiketten beschrieben werden kann.

Die Herleitungen benutzen den Greedy-Algorithmus und Kontraktionsargumente.

Almost optimal explicit constructions of asymptotically good packings

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A (n,k,l)-packing is a family of k-subsets choosen from a n-set such that each l-subset is contained in at most one of the k-subsets. The sequence of packings is called asymptotically good (a.g.) if the number of k-subsets $\sim \frac{\binom{n}{l}}{\binom{k}{l}}$ as $n \to \infty$. In 1985 Rödl proved by the probabilistic method long-standing conjecture of Erdős and Hanani that for fixed l and k a.g. (n,k,l)-packings exist. In 1995 Grable found the derandomization of this proof. We give explicit construction of a.g. packings of 'almost linear' complexity, i.e. an algorithm that given l, k, n and i as input finds ith k-subset of a.g. packing in time $O(L(\log L)^{const})$, where $L = \log(l+1) + \log(k+1) + \log(n+1) + \log(i+1) = O(\log n)$ is the input size.

Counting Walks on Jacobi-Graphs: an Application of Orthogonal Polynomials [1]

Wolfdieter L a n g [2]

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Open and closed chain graphs with N vertices have tridiagonal (Jacobi) adjacency matrices $\mathbf{J}_N$. The generating function $\Gamma_N(p_n \to p_m, z)$ for the number of walks $w_{N,L}(p_n \to p_m)$ of given length L from one vertex, p_n, to another one, p_m, is computed in terms of the orthogonal polynomials associated with these Jacobi matrices.

For special examples of classical orthogonal polynomials (Chebyshev $\{U_k\}$ and Laguerre $\{L_k\}$) the generating function $G(N,z) := \frac{1}{N}\sum_{n=1}^{N} \Gamma_N(p_n \to p_n, z)$ for the (normalized) total number of round trips of length L is given explicitly. The infinite vertex number limit $N \to \infty$ of $G(N,z)$ (with appropriate scaling in the Laguerre case) is also found.

[1] AMS MSC numbers: 05C38, 05C50, 33C45

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Recognizing perfect 2–split graphs

C.T. HOÀNG (Lakehead, Canada) and V.B. LE (Rostock)

A graph is a split graph if it vertices can be partitioned into a clique and a stable set. A graph is a k-split graph if it vertices can be partitioned into k sets each of which induces a split graph. We show that the Strong Perfect Graph Conjecture is true for 2-split graphs and design a polynomial algorithm to recognize a perfect 2-split graph.

On subword orders

Uwe Leck, Rostock

We consider the poset P whose elements are all words over a finite alphabet Ω where a word x is smaller than y if x can be obtained from y by deleting letters.

It is known that for $|\Omega| = 2$ the *vip*-order gives a Kruskal-Katona type theorem for P. We will discuss this and related results for the $|\Omega| = 2$ case.

Finally, we give a counterexample to a conjecture of Daykin who suggested a generalization of the *vip*-order for $|\Omega| > 2$.

Nonisomorphic Drawings of Graphs

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We discuss nonisomorphic drawings of small graphs in the plane. In general, not much is known about the number of such drawings. In the talk we give an overview on this topic and present a (slow) algorithm to construct all nonisomorphic drawings of a graph. In particular, we discuss all connected graphs on 6 vertices.

W. Mader: Topological subgraphs in graphs of given average degree.

It is well known that for every positive integer n there is a least integer f(n) such that every finite graph of minimum degree f(n) contains a subdivision of the complete graph K_n. We survey recent results on this function f and related results, imposing further conditions on the graphs or the subdivisions, and compare them to results on minors K_n.

The Penrose Polynomial

HANS MIELKE
Freie Universität Berlin

In his thesis, Roger Penrose describes a relationship between certain algebraic objects and colorings of plane graphs. This connection gave rise to the so called Penrose Polynomial. This polynomial has interesting combinatorial applications, e.g. $P_G(3)$ counts the edge-3-colorings of 3-regular graphs, $P_G(-2)$ is related to the number of region-4-colorings, and if the coefficients do always alternate, this implies the Four Color Theorem.

In the talk, we will have a closer look at some coloring problem and see in which way the geometric structure of the graph is used. Furthermore, we will generalize this polynomial to Matroids and to Bouchet's Multimatroids. We will also encounter the Tutte Polynomial.

Kreuzkorrelation linearer Schieberegisterfolgen

EVA NURIA MÜLLER, FU BERLIN

Sind zwei maximale lineare Schieberegisterfolgen $(a_i)_{i\in\mathbb{N}}$ und $(b_i)_{i\in\mathbb{N}}$ der Länge $p^n - 1$ über $GF(p)$ gegeben, so existiert ein $d \in \mathbb{N}$ mit $\text{ggt}(d, p^n - 1) = 1$, so daß o.B.d.A. $b_i = a_{di}$ für alle $i \in \mathbb{N}$ gilt. Die Kreuzkorrelation $C_d(t)$ der Folgen $(a_i)_{i\in\mathbb{N}}$ und $(b_i)_{i\in\mathbb{N}}$ berechnet sich dann durch $C_d(t) = \sum_{i=0}^{p^n-2} \zeta^{a_{i-t}-a_{di}}$, wobei ζ eine komplexe primitive p-te Einheitswurzel ist. Von besonderem Interesse ist hierbei die Anzahl der Werte von $C_d(t)$ sowie $|1 + C_d(t)|$. Bisher wurden fast ausschließlich Werte von d mit $\text{ggt}(d, p^n - 1) = 1$ untersucht.

In meinem Vortrag werde ich zwei Ergebnisse vorstellen, bei denen $\text{ggt}(d, p^n - 1) = 2$ gilt, nämlich die Fälle:

- p ungerade, n ungerade, $d = p^k + 1$,
- $p = 3$, n ungerade, $d = \frac{p^n+1}{4} + \frac{p^n-1}{2}$.

The constructive facet-generating methods for the linear ordering polytope.

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Otto-von-Guericke University Magdeburg, State University Minsk

Abstract. The **linear ordering polytope** P_n is defined as the convex hull of the 0-1 characteristic vectors of all acyclic tournaments in a complete digraph $D_n = (V, E), |V| = n$. We discuss the facial structure of P_n, i.e. a description by system of linear equations and inequalities. Up to now the complete linear descriptions of P_n are known for $n \leq 7$. We introduce the constructive methods (Rotation and Extension) for generating of facets of P_n by using known ones.

Polyhedral Description of Multicolorings

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Let G denote a simple graph with vertices $v_1, \ldots, v_N$, and let C be a positive integer. A vector $\mathbf{n} = (n_1, \ldots, n_N) \in \mathbb{Z}_+^N$ is called C-colorable if and only if there exists a set-coloring with C colors of G assigning n_i colors to vertex v_i, $i = 1, \ldots, N$. The set of all C-colorable vectors is denoted by $\mathcal{S}_C$.

For the stochastic analysis of certain frequency assignment problems in cellular telecommunication networks, a compact description of $\mathcal{S}_C$ is necessary.

In the talk we will present results characterizing the elements of $\mathcal{S}_C$ by means of linear inequalities.

This is joint work with J. Kind from Aachen.

Ein Bijektionsbeweis für die Euler-Stirling-Identität

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Die Identität

$$\sum_\rho 2^\rho \binom{n}{\rho}\binom{k}{\rho} = \sum_\rho \binom{n}{\rho}\binom{n+k-\rho}{n}$$

stellt einen bemerkenswerten Zusammenhang dar, in den auch die Euler-Frobenius-Zahlen und die Stirling-Zahlen 2. Art einbezogen sind. Sie kann in der allgemeineren Form

$$\sum_\rho (u+v\,w)^\rho\, v^{n-\rho}\, w^{k-\rho}\binom{n}{\rho}\binom{k}{\rho} = \sum_\rho v^{n-\rho}\, u^\rho\, w^{k-\rho}\binom{n+k-\rho}{n}\binom{n}{\rho}$$

mit Hilfe erzeugender Funktionen für beliebige komplexe u, v, w bewiesen werden (Sonderfall $u = v = w = 1$), ist aber i. a. nicht auf eine geschlossene Form im Sinne von Wilf-Zeilberger reduzierbar.
Nach einigen historischen Bemerkungen geben wir einen elementar-kombinatorischen Bijektionsbeweis. Dabei deuten wir die Identität im Rahmen einer Abzählungstheorie für Interferenzcodes zweier sortierter Folgen, ausgehend von einem auf Cowan-Delannoy-Stanton zurückgehendes Zahlenarray.

Haar Graphs

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Haar graph $H(n)$ is a bipartite graph obtained from a biadjacency matrix $B(n)$ that is a circulant matrix with the first row composed of the binary vector $b(n)$ corresponding to the binary representation of n. It turns out that each Haar graph is a bipartite Cayley graphs for a dihedral group, although the converse is not true. However, all bipartite circulant graphs form a subclass of Haar graphs. Several interesting graphs include $H(11)$, $H(69)$, and $H(133)$. Haar graphs contain some infinite families of graphs, such as even cycles, odd Möbius ladders, even prisms, complete bipartite graphs, and Levi graphs of cyclic n_3 configurations. Motivation for our interest and naming of Haar graphs comes from the study of the so-called Schur norms of matrices that admit, for the biadjacency matrices $B(n)$ of Haar graphs, a closed form expression via Haar measure on a cyclic group.

*This is a joint work with Milan Hladnik (Milan.Hladnik@fmf.uni-lj.si), and D. Marušič (Dragan.Marusic@uni-lj.si).

Computation of the Folkman Number F(3,3;5)

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With the help of computer algorithms we prove that 15 is the exact value of the (edge) Folkman number $F_e(3,3;5)$, which is defined as the smallest positive integer n, such that there exists a K_5-free graph on n vertices, whose every coloring of the edges with two colors contains a monochromatic triangle. We construct all critical graphs on 15 vertices for this number and present some of their properties. Similarly, we obtain $F_v(3,3;4) = 14$ and all K_4-free critical graphs for the (vertex) Folkman number, where instead of the edges we color the vertices. The exact values of both numbers were previously unknown, and both were the smallest open cases of a general problem of computing edge- and vertex- Folkman numbers $F(k,l;m)$, respectively.

All computations were performed at least twice with independent implementations of algorithms written by different authors.

A Vizing-type bound for the chromatic number

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Vizing's classical result concerning edge colouring says that the chromatic index of a simple graph is at most its maximal degree plus one. If a simple graph G is not a triangle, then Vizing's result can be restated in terms of line graphs: If H is the line graph of G, then H has chromatic number at most its clique number plus one. Beineke characterized line graphs of simple graphs by 9 forbidden induced subgraphs, for instance the claw $K_{1,3}$ and $K_5 - e$. Javdekar conjectured that the Vizing-type bound for the chromatic number already holds for the class of graphs not containing $K_{1,3}$ and $K_5 - e$ as an induced subgraph. Finally, this was proved by Kierstead in 1984. It is due to Dhurandhar in 1989 that the same bound holds also for the class of $K_{1,3}$ and $(K_2 \cup K_1) + K_2$ free graphs. We examine whether both results are also valid if we replace the claw by the chair $C_{2,1,1}$, i.e. a claw with exactly one edge subdivided.

On the differences between the upper irredundance, upper domination and independence numbers of a graph

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Let $G = (V, E)$ be a graph and β, Γ and IR its independence, upper domination and upper irredundance number respectively. We present sharp upper bounds on the differences $IR - \beta$, $\Gamma - \beta$ and $IR - \Gamma$ for general graphs and graphs with restricted maximum degree. Furthermore we prove that for every $l \geq 3$ there are 1-connected, l-regular graphs for which the difference $IR - \Gamma$ is arbitrarily large. This second part is related to a conjecture of Henning and Slater (1996) and our results complement the original disproof given by Cockayne and Mynhardt (1997).

Closure and Stable Properties in Claw-Free Graphs

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If G is a claw-free graph, then there is a graph cl(G) (called the *closure* of G) such that (i) G is a spanning subgraph of cl(G), (ii) cl(G) is the line graph of a triangle-free graph, (iii) G is hamiltonian if and only if cl(G) is hamiltonian.

We discuss the behavior of some further cycle and path properties (such as e.g. traceability, pancyclicity, hamiltonian connectedness, 2-factor, cycle covering etc.) under the closure operation.

Joint work with S. Brandt, Berlin, O. Favaron, Orsay, A. Saito, Tokyo and R.H. Schelp, Memphis.

Colouring Problems for 4-regular Hamiltonian Graphs

GERT SABIDUSSI

Starting with the Cycle-plus-triangles Theorem (every 4-regular graph which is the edge-disjoint union of tringles and a hamiltonian cycle is 3-colourable), we discuss the possibility of 3-colour theorems for other types of 4-regular hamiltonian graphs as well as the question of the existence of large independent sets in such graphs. Most reaults obtained so far are negative (NP-completeness), underlining the exceptional nature of the Cycle-plus-triangles theorem.

On a strange observation in the theory of the dimer problem.

Peter E. John and Horst Sachs, Ilmenau

Abstract.

Let A_n denote the number of ways a $2n \times 2n$ chessboard C can be completely covered with $2n^2$ dominoes such that every domino covers two adjacent squares of C. The following formula is a classical result of Fisher/Temperley and Kasteleyn(1961).

$$A_n = \prod_{j=1}^{n} \prod_{k=1}^{n} (u_j^2 + u_k^2) \quad \text{where } u_k = 2\cos\frac{k\pi}{2n+1}.$$

Set $A_n = 2^n B_n^2$, $B_n > 0$.
It can easily be proved that B_n is rational as well as integral. We show that the statement

$$B_n \equiv \begin{cases} n+1 & \text{if } n \text{ is even} \\ (-1)^{\frac{n-1}{2}} n & \text{if } n \text{ is odd} \end{cases}, \bmod 2^q$$

is true for $q = 5$ (thus also for $q = 1, 2, 3, 4$) and false for $q = 6$ (thus also for $q > 6$).

On Extremal Problems Concerning Weights of Edges of Graphs

STANISLAV JENDROĽ, INGO SCHIERMEYER

Abstract

The weight $w(e)$ of an edge $e = uv$ of a graph G is defined to be the sum of degrees of the vertices u, v. This concept of the weight of an edge was introduced by Kotzig who proved the following beautiful result: Every planar 3-connected graph contains an edge of the weight not exceeding 13. This result was further developed in various directions.

At the Fourth Czechoslovak Symposium on Combinatorics held in Prachatice 1990 Paul Erdös asked the following question: What is the maximum value for the minimum weight of an edge e for all graphs G having n vertices and m edges?

In 1991 Ivančo and Jendrol determined this maximum value for the minimum weight for all graphs with at most n-1 edges and for complete graphs missing at most n-2 edges, respectively. Moreover, they stated a conjecture for the general case.

In this talk we will present a proof of this conjecture.

On check digit systems with error correction

Ralph-Hardo Schulz (Freie Universität Berlin)

We continue the investigation of check digit systems which allow to correct single errors or adjacent transpositions (SEC-ATC codes). Taking the elements of the additive group of a vector space or of a finite field as the digits of the alphabet, we give examples using check equations with two automorphisms (given by matrices and multiplication with elements respectively).

Suborthogonal Double Covers by Complete Bipartite Graphs

ULRIKE SCHUMACHER
UNIVERSITÄT ROSTOCK

The well known concept of orthogonal double covers was generalised by suborthogonality. We look for a collection of subgraphs of the complete graph K_n all being identical copies of a given graph G (called pages) such that every edge of the K_n is contained in exactly two pages and two pages have at most one edge in common. The study of suborthogonality is motivated by the equivalence between suborthogonal double covers of the complete graph by a smaller complete graph and super-simple designs. We will regard the example G being a complete bipartite graph and give a solution for some special classes of complete bipartite graphs.

Handicap Achievement for Square Animals

MARKUS SEEMANN, *Theoretische Informatik, Technische Universität Braunschweig*

Abstract. Achievement games for square animals or *polyominoes* were introduced by Frank Harary. Two players A and B alternately mark the cells of the tessellation of the plane. An animal L is called a *winner* if the first player A can mark an entire copy of L regardless of the moves made by B. In handicap achievement games, player A marks a fixed number of cells before the achievement game begins. L has the *handicap number* n if L is a winner if and only if A is allowed to mark n cells before the beginning of the game.
As results of a common work with Heiko Harborth, the exact handicap numbers are presented for all square animals with up to five cells, except that animal formed by five cells in a row. Lower and upper bounds for the handicap numbers of some animals with six cells are given.

Non-Extendable Laces and Loops of Congruent Circles in the Plane

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A family $\{C_1, \ldots, C_n\}$ of pairwise distinct, non-overlapping, congruent circles in the plane form a *lace* provided C_i touches C_{i+1} for all $i = 1, \ldots, n-1$. If, additionally, C_n touches C_1, the lace is named a *loop*. A lace (loop) $\{C_1, \ldots, C_n\}$ is called *extendable* if it is properly contained in another lace (respectively, loop). In the report various problems and results on minimum lengths of non-extendable laces and loops are discussed.

Zu Maximalstromalgorithmen in geschichteten Transportnetzen

MARTIN SONNTAG und ULRICH HETZEL

Geschichtete Transportnetze sind spezielle paare, kreisfreie Transportnetze, die unter anderem bei der Modellierung von Zuordnungsproblemen auftreten.
Diese Praxisrelevanz ist die Motivation für die Anpassung bekannter Maximalstromalgorithmen an die besonderen Struktureigenschaften solcher Transportnetze. Es werden für geschichtete Transportnetze zwei Algorithmen (ein *2-Phasen-Preflow-Push-Algorithmus* und ein *FIFO-Preflow-Push-Algorithmus* mit *Lücken-Suche-Technik*) vorgestellt und hinsichtlich ihrer Komplexität und Rechenzeit mit aus der Literatur bekannten Algorithmen verglichen. Die mit dem FIFO-Preflow-Push-Algorithmus mit Lücken-Suche-Technik erzielten Rechenzeiten liegen bei den verwendeten Testbeispielen (ca. 3500 Knoten und 16000 Kanten) um rund zwei Zehnerpotenzen unter den der bekannten Algorithmen.

On Upper Bound Conjectures for Combinatorial Pseudo-k-manifolds

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A simplicial complex is called a combinatorial d-manifold if the link of every vertex is a triangulated $(d-1)$-sphere and a d-dimensional combinatorial pseudo-1-manifold is a simplicial complex whose vertex links are combinatorial $(d-1)$-manifolds. Now combinatorial pseudo-k-manifolds are recursively defined in an obvious way.
In this lecture we present several Upper Bound Conjectures for such complexes allowing a fixed-point involution acting on the triangulation. We begin with an Upper Bound Theorem for the Euler-characteristic of combinatorial 4-manifolds, including a discussion of equality. A first generalization of this result conjectures similar Upper Bounds for arbitrary even dimensions, a second one concerns an Upper Bound Conjecture for pseudo-k-manifolds. All the conjectures can be verified in many special cases.

On the Enumeration of (symmetrical) combinatorial structures

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Abstract: We describe an algorithm which was first used to find all triangulations of oriented neighbourly 2-manifolds with a given number of vertices (K_{12}). Our motivation to try to enumerate and list triangulated closed manifolds comes from the open question:

> Does there exist a closed, connected, orientable triangulated 2-manifold that cannot be embedded in 3-space without selfintersections ?

Pascal – Like Triangles in the Enumeration of Trees and Sequences

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Catalan numbers enumerate regular trees and also $\{0,1\}$–sequences $x^{sn} = (x_1, \dots, x_{sn})$ of weight (= number of 1's) $wt(x^{sn}) = n$ fulfilling the condition that for every initial segment $(x_1, \dots, x_i)$

$$wt(x_1, \dots, x_i) \geq \frac{i}{s} \qquad (1)$$

Such sequences occur in Probability Theory in the analysis of the ballot theorem and the first passage time of a special random walk. We are now interested in the number of $\{0,1\}$–sequences defined similarly as above, namely condition (1) is replaced by $wt(x_1, \dots, x_i) \geq \frac{l}{s} i$. So any rational number $\frac{l}{s}$ is allowed now. There seems not to exist a closed formula for these numbers in general, so it might be of interest to have a low complexity algorithm to compute them. We suggest an approach via a Pascal – like triangle defined by the initial values $b(0,0) = 1, b(0,k) = 0$ for $k \neq 0$ and $b(n,k) = 0$ for $k < 0$ and a recursion changing from row to row, for instance in the case $s = 5, l = 2$:

$$b(n+1,k) = \sum_{j=-1}^{\infty} b(n,k+j) \text{ for } n \equiv 1 \bmod 2, \quad b(n+1,k) = \sum_{j=-2}^{\infty} b(n,k+j) \text{ for } n \equiv 0 \bmod 2$$

Zur Summenzahl von Hypergraphen

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Ein Hypergraph $\mathcal{H}$ heißt genau dann *Summenhypergraph*, wenn es eine endliche Menge $S \subset \mathbb{N}^+$ und $d_1, d_2 \in \mathbb{N}^+$ mit $1 < d_1 \leq d_2$ so gibt, daß $\mathcal{H}$ isomorph zum Hypergraphen $\mathcal{H}^+_{d_1,d_2}(S) = (V, \mathcal{E})$ ist , wobei $V := S$ und

$$\mathcal{E} := \{\{x_1, x_2, \ldots, x_k\} : k \in \{d_1, d_1 + 1, \ldots, d_2\} \wedge (i \neq j \Rightarrow x_i \neq x_j) \wedge \sum_{i=1}^{k} x_i \in S\}.$$

Für einen beliebigen Hypergraphen $\mathcal{H}$ ist die *Summenzahl* $\sigma = \sigma(\mathcal{H})$ definiert als die minmale Anzahl isolierter Knoten $w_1, \ldots, w_\sigma \notin V$, so daß $\mathcal{H} \cup \{w_1, \ldots, w_\sigma\}$ ein Summengraph ist. Für $S \subset \mathbb{Z}$ erhalten wir die Begriffe der Integralsummenhypergraphen und der Integralsummenzahl $\zeta(\mathcal{H})$.
Wir bestimmen $\sigma(\mathcal{K}^d_n)$ und geben Schranken für $\zeta(\mathcal{K}^d_n)$ an, wobei $\mathcal{K}^d_n$ den vollständigen d–uniformen Hypergraph mit n Knoten bezeichnet. Weiterhin zeigen wir, daß für $d \geq 3$ jeder d–uniforme Hyperbaum $\mathcal{B}$ ein Integralsummenhypergraph ist, d. h. $\zeta(\mathcal{B}) = 0$.

On the number of qualitatively different job shop problems

Thomas Tautenhahn *

In the classical job shop scheduling problem, n jobs have to be processed on m machines with given technological orders. These orders can be described by an $n \times m$-matrix where each row contains a permutation numbers $1, \ldots, m$. The computational complexity of the scheduling problem heavily depends on this matrix. We call two such matrices isomorphic if one can be obtained from the other by renumbering rows and columns or by additionally reversing all permutations. We consider different approaches to determine the number of nonisomorphic machine order matrices of a fixed format and we derive a formula for this number.

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Vertex pancyclic digraphs

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One of the fundamental results on Hamiltonian cycles in digraphs is due to Ghouila-Houri (1960): A strong digraph D on n vertices where $d^+(x) + d^-(x) \geq n$ for every vertex $x \in V(D)$ is Hamiltonian. As an easy consequence, every digraph on n vertices having minimum degree at least $n/2$ contains a Hamiltonian cycle. In 1976, Häggkvist and Thomassen proved that Ghouila-Houri's condition even implies pancyclicity unless n is even and D is isomorphic to the complete bipartite digraph $K^*_{\frac{n}{2},\frac{n}{2}}$. We show that this is no longer true when we consider vertex pancyclicity and that a digraph with minimum degree at least $n/2$ is vertex pancyclic except for a well determined family of digraphs.

Paths in tournaments, a proof of Rosenfeld's conjecture.

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Let T be a tournament on n vertices, and $I \subseteq \{1, \ldots, n-1\}$, we say that T *realizes* I if there exists an enumeration $\{x_1, x_2, \ldots, x_n\}$ of the vertices of T such that $x_i \rightarrow x_{i+1}$ if and only if $i \in I$. For example, the well-known theorem of Rédei (1934), *every tournament has an hamiltonian path* can be stated as : *every tournament realizes* $\{1, \ldots, n-1\}$. In 1971, Grünbaum proved that : *apart three tournaments, every tournament realizes* $\{2k+1 : 1 \leq 2k+1 \leq n-1\}$. Those three tournaments which fail to contain an alternated path are 1) The cycle on three vertices 2) The regular tournament on 5 vertices 3) The Paley tournament on 7 vertices. A year later, Rosenfeld gave a new proof of Grünbaum's result and proposed the following problem : Call a tournament T on n vertices *path-universal* if it realizes every subset of $\{1, \ldots, n-1\}$. Conjecture: Only finitely many tournaments are not path-universal. In 1981, Thomason proved this conjecture : *If a tournament has at least* 2^{128} *vertices then it is path-universal.* We completely settle Rosenfeld's conjecture: *Apart the 3 Grünbaum's examples, every tournament is universal.*

The Subgraph Degree Polytope

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Let G be a fixed undirected graph without loops. If H is a spanning subgraph of G, its degree vector $x^H \in \mathbf{R}^{V(G)}$ is defined by $x_v^H := \deg_H(v)$ for all vertices $v \in V(G)$. The subgraph degree polytope of G is the convex hull of the degree vectors of all the spanning subgraphs of G. Among other things, we characterize the facets and the vertices of this polytope. (Joint work with Jens Vygen, Bonn).

Open Problems in Dimension Theory for Partially Ordered Sets

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We discuss some long standing open problems in dimension theory for partially ordered sets. These combinatorial problems are closely related to many well known problems in graph theory and extremal combinatorics. Three examples are:

1. Does every poset contain a pair whose removal decreases the dimension by at most one.
2. Does there exist a n-dimensional poset P so that $P \times P$ is also n-dimensional?
3. Is every finite 3-dimensional poset representable as an inclusion order using circles in the plane?

Vertex - Folkman numbers

SEBASTIAN URBANSKI

Following the arrow notation, for a graph G and natural numbers $a_1, a_2, ..., a_r$ we write $G \rightarrow (a_1, a_2, ..., a_r)^v$ if for every coloring of the vertices of G with r colors there exists a copy of complete graph K_{a_i} of color i for some $i = 1, 2, ..., r$. The pigeon-hole principle trivially implies that for $m = \sum_{i=1}^{r}(a_i - 1) + 1$ and for every graph H containing K_m we have $H \rightarrow (a_1, a_2, ..., a_r)^v$. We present constructive bounds on the order of the smallest graphs with this Ramsey property, but not containing large cliques.

Sachstriangulations and infinite sequences of regular hypermaps of closed oriented surfaces

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In 1963 at the Conference in Smolenice (Slovakia) H. Sachs proposed to investigate finite groups by assigning to any finite group a set of triangulations of closed oriented surfaces, called Sachs triangulations. This assignment has been used in constructing reflexible regular maps on closed oriented surfaces. Recently this method has been used for the construction of infinite sequences of reflexible regular hypermaps with given edge size $l > 2$, given vertex degree $r > l + 2$, and given face size $b > 2l + r$.

Full Equi-intersectors in Euclidean and in Spherical Geometry

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A geometric graph is called a full equi-intersector, if any two edges intersect, if the number of edges equals the number of vertices, and if all edges have the same lengths. The relation between planar geometric graphs which are full equi-intersectors and Reuleaux polygons is studied. It is shown that there is a one-to-one correspondence between these objects. This is used to present exhaustive constructions of Reuleaux polygons of arbitrary (odd) order n. The obvious construction is running in quadratic time, but more careful investigations lead to a refined version, running in $0(n)$ time. This construction is considered in Euclidean and in spherical geomtry. It is shown that the situation in the sphere is different from the Euclidean case for large diameters of the vertex set. But if the diameter remains below half of the diameter of the sphere all arguments from the Euclidean case apply in a similar way to the spherical case.

Ein weiteres Gegenbeispiel zur Borsukschen Vermutung

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In 1933 K. Borsuk raised the question whether every bounded set $M \subset E^d$, card$M \geq 2$, can be covered by at most $d+1$ sets of smaller diameter than M.

J. Kahn and G. Kalai showed in 1992 that this is not the case. The smallest dimension d for which they obtained a counterexample is $d = 946$. We show here that such a counterexample already exists for $d = 903$. The proof follows a pattern from the construction of A. Nilli.

MSC: 52A20
Keywords: Borsuk's problem

On densest packings of 3–spheres

J.M. Wills

The densest lattice packing of 3–spheres is known since Gauss. It is the fcc (face-centered cubic) lattice, and its structure is adopted by some crystals. In 1894 Barlow discovered infinitely many periodic packings of same density 0.74048. Among them is the hexagonal close–packed hcp, which occurs as crystal, too.

All these structures are infinite, whereas crystals are (large but) finite. So: What are the best (densest) finite large sphere packings of this type? Recently U. Schnell gave an answer to this problem with methods developed by J.M.W. and himself, and his result reflects the frequency of these special crystals in nature. Nothing is known about nonperiodic sphere packings according to the Kepler problem, which is still open.

On Waring's Problem in Finite Fields

ARNE WINTERHOF

Let p^n be a prime power and $g(k,p^n)$ be the smallest s such that every element of $\mathbf{F}_{p^n}$ is a sum of s kth powers in $\mathbf{F}_{p^n}$. It is shown that for $k|p^n-1$

$$g(k,p^n) \leq \lfloor 32 \ln k \rfloor + 1 \text{ for } p^n > k^2$$

and

$$g(k,p^n) \leq n g(d,p);\ d = \frac{k}{(k, \frac{p^n-1}{p-1})} \text{ for } \frac{p^n-1}{p^d-1} \not| k \ \forall n \neq d|n.$$

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